



Remote machinery diagnostics:

*A cost-effective way to improve plant safety,
productivity and profitability*

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For more than twenty years, Bently Nevada's Machinery Diagnostic Services (MDS) engineers have helped our customers solve machinery problems. Traditionally, an MDS engineer traveled to a plant site with portable data acquisition and analysis equipment, recorded machinery information, and returned to his office to generate a report. Today, we can respond faster, using Bently Nevada's more powerful portable systems, such as ADRE® for Windows. New technology has greatly reduced the time from an event to an action. We can acquire, reduce and analyze vibration data, and generate diagnostic reports, at the plant site. We can transmit data over telephone lines to other MDS engineers for additional analysis and have a report ready in hours.

Many MDS projects involve acceptance testing of new machinery at a manufacturer's factory or at a plant site. An MDS engineer works on-site as an integral member of the startup commissioning team. Generally, these projects are planned in advance and experience very few machine problems.

However, a significant amount of our work is urgent: Customers with machinery problems that require immediate attention. Generally, we can have an

engineer on-site in less than a day, regardless of location, because we have engineers located in most parts of the world. Even so, when a machinery problem develops very rapidly, it is vital to quickly assess the machine's condition and fitness for continued operation. Such a decision may require a detailed diagnostic survey of the machine. While it may be economically justifiable to have an MDS engineer travel to the plant site to perform the diagnostic work, a better solution is available today - remote diagnostics.

Move data not people

Remote diagnostics takes advantage of a simple idea - moving data from the plant site to the diagnostics engineer. We can transfer data in several ways. In most cases, we transfer data over telephone lines via high speed modem, as it provides the quickest response time. However, we can also copy data that has been posted to a customer's or our electronic bulletin board. Depending on the circumstances, it may be sufficiently timely, and certainly economical, to send data through the mail on floppy or removable hard disk.

Moving data, and not people, keeps costs low by saving the expense of transporting an engineer and his equipment to the plant site. Airline tickets and freight alone may run to several thousand U.S. dollars. An engineer's value is in the time he spends evaluating a machine, not the time spent traveling to the site.

Requirements for effective remote diagnostics

Remote diagnostics uses current technology to establish direct communications between MDS engineers and machinery based in a distant location. However, remote diagnostics involves more than connecting an MDS engineer with a plant site via a telephone and a pair of modems. Several vital considerations must be addressed before establishing a successful remote diagnostics program. They include:

- Documenting the machinery design and the process within which it operates.
- Establishing a database definition for each machine train.
- Establishing a reference data set that characterizes the normal behavior of each machine train.
- The on-site data acquisition and reduction systems.

Machinery and process documentation is necessary

An engineer who performs machinery diagnostics must know the machinery's design characteristics, whether diagnostic work is carried out on-site or remotely. For remote diagnostics, machine design details must be thoroughly documented in a preliminary on-site survey. The survey should also document the interaction of each machine with the process or system. While always very helpful to the diagnostic process, such documentation is essential. ►

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Remote diagnostics preparation requires substantial on-site effort by Bently Nevada MDS and the plant's operations and maintenance engineers, with management's support.

On-site equipment and baseline report requirements

Fast, accurate diagnostics requires detailed machine vibration information in both a current and an historical database. The database must be defined when the diagnostics strategy is defined, and includes vibration and position measurements, and process and machine variables. It must include all measurements that define machinery behavior under normal and malfunction conditions.

An effective plant-based data acquisition system must be installed. MDS can perform remote diagnostics from databases created with ADRE® for Windows. However, the most effective programs are based on online systems which provide historical information. Bently Nevada's Dynamic Data Manager® 2 System is an online system which provides a detailed trend database and comprehensive dynamic data when it is needed. Our Transient Data Manager® 2 System provides the same data plus automatic data acquisition during startup and shutdown, which is especially important for large turbomachinery systems.

Engineer Assist™ Online adds automated diagnostics to both the Dynamic Data Manager 2 and Transient Data Manager 2 Systems. Its diagnostic reports are invaluable - they greatly improve the speed and accuracy of malfunction diagnostics. MDS engineers use Engineer Assist reports during remote diagnostics to focus on the most crucial information at the earliest time. Plant personnel can use Engineer Assist Online to obtain important early information on the nature and severity of a problem.

During the setup phase of a remote diagnostics program, MDS and plant

engineers use the on-site data acquisition system to create baseline records of the behavior of each machine train under normal process conditions. They use Engineer Assist audits to identify any malfunctions that may be at an early stage of development.

The benefits of remote diagnostics

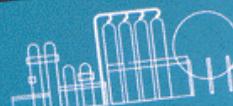
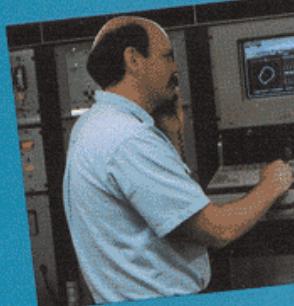
Bently Nevada's remote diagnostics service enables plant-based operations and maintenance engineers to work with MDS as a team. *With remote diagnostics, MDS expertise is available at any plant site 24 hours a day, 365 days a year.* The cost of continuously-available MDS support is very small compared to the benefits available.

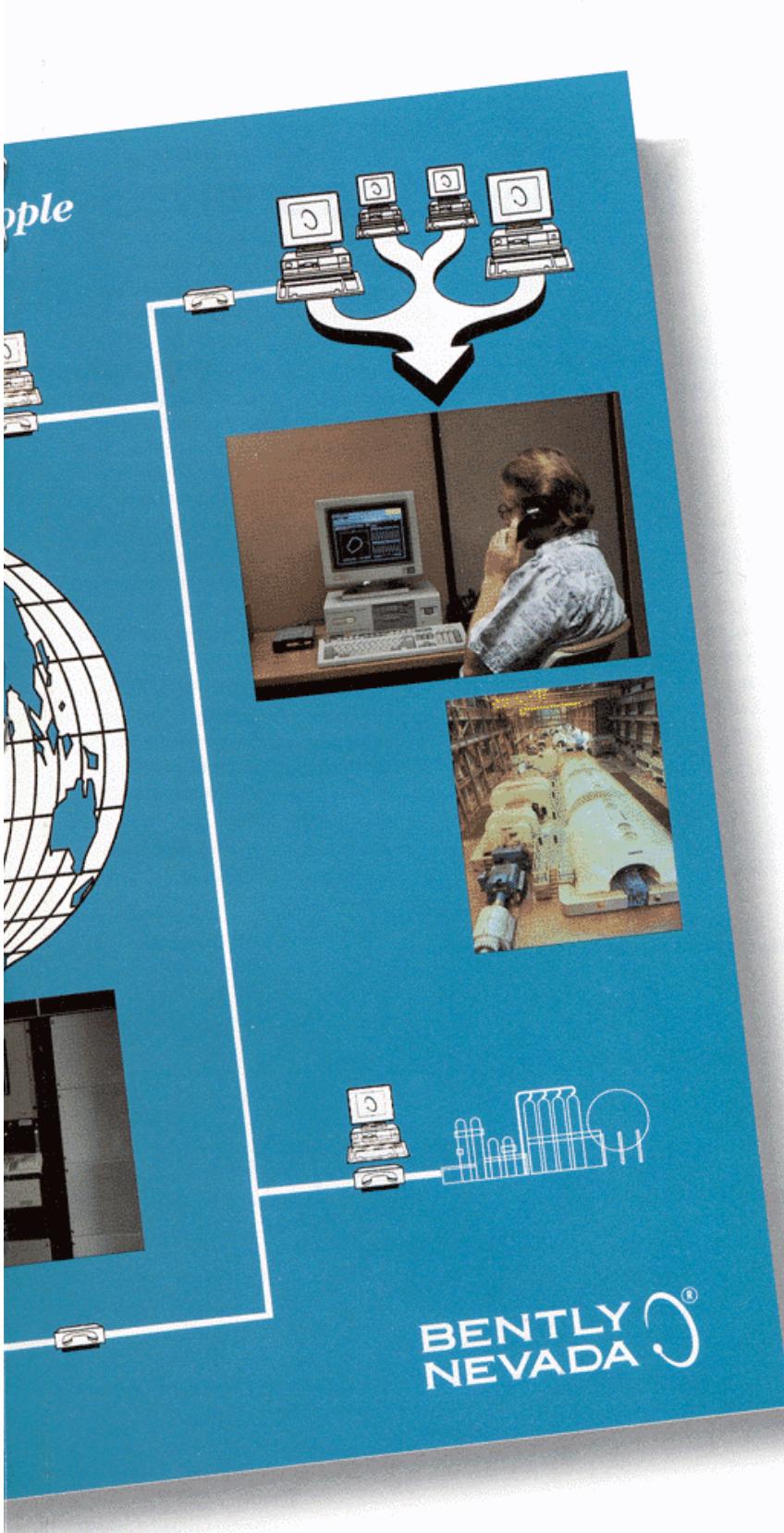
Consider the following scenario: As a result of a process upset, a steam turbine-driven compressor train exhibits abnormal vibration and thrust position characteristics. It is difficult to maintain process flows at required levels because maintaining the required compressor speed causes the machine's condition to deteriorate. The compressor train is unspared and is critical to production.

The plant generates \$2 million of product per day. An in-service machine failure could cause a plant outage of several weeks. The plant's Dynamic Data Manager 2 (DDM2) System shows an Acceptance Region alarm on the turbine bearings. It indicates that a sudden 1X vibration amplitude change occurred after the upset. The on-site Engineer Assist system audited the machine, and its report describes an abnormal 1X vibration vector change and abnormal turbine rotor thrust condition. It is 2 AM on Sunday. The shift operations manager calls Bently Nevada MDS for assistance before shutting the machine down.

The shift operations manager briefly discusses the problem with our on-duty MDS engineer. Then, our MDS engineer connects his diagnostic equipment by modem to the on-site DDM2 System and reviews its current value and trend files.

...Move data, not people





He also downloads and reviews the Engineer Assist files. The MDS engineer responds with a hard copy diagnostic report sent directly to the control room fax machine. After a brief telephone discussion, the shift operations manager makes adjustments to the process, resulting in a stable machine condition and continued production. Four weeks later, remedial action is taken during a planned outage. Spares have been prepared and resources made ready to turn the outage around in the minimum possible time. New baseline data is created for the machine during startup, and MDS conducts a remote survey which shows that the machine train is operating satisfactorily.

The MDS engineer who performed the emergency diagnostics was located 6000 miles from the plant; the engineer who performed the recommissioning survey was located 200 miles away. The total cost, including the machine's recommissioning survey and online communication costs, was \$4000.

Remote diagnostics for general-purpose machines

We can also perform remote diagnostics on general-purpose machines. MDS can acquire vibration and process data over the phone lines from sites that are equipped with Trendmaster® 2000 for Windows.

Trendmaster 2000 for Windows is Bently Nevada's online periodic monitoring and information management system for general-purpose machines. Shared data cables make it economical to install; Microsoft® Windows gives it a comfortable "look and feel," and its many display formats give it diagnostic power. Trendmaster 2000 for Windows automatically collects, trends and provides alarms for any number of vibration and process transducers. It is a cost-effective way to manage any number of smaller machines.

The best solution for you

Bently Nevada's remote diagnostic services are available under various contractual agreements. We will work with your engineering department to provide the best solution for you. Contact your nearest sales representative for more information. ■